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An Insole Leather Tester

I. D. CLARKE and R. M. FLAHARTY

Eastern Utilization Research Branch
Agricultural Research Service
U. S. Department of Agriculture

During the war, the need for insole leather of better quality became evident. Work on the improvement of this type of leather made desirable, or even necessary, a rapid laboratory method for testing insole quality. Machines for this purpose have been devised and described [1], [2]. A machine which performs essentially the same operation as those referred to, that is, one which flexes leather under pressure, has been devised, built and used in this laboratory, and is described briefly here because it has been used to determine the relative durability of vegetable–and alum–retanned insoles [3].

The machine, without the cover for retaining heat and moisture, is shown in Figure 1. Four specimens can be flexed at one time. Figure 2 shows the working parts involved in flexing a specimen and applying pressure to it.

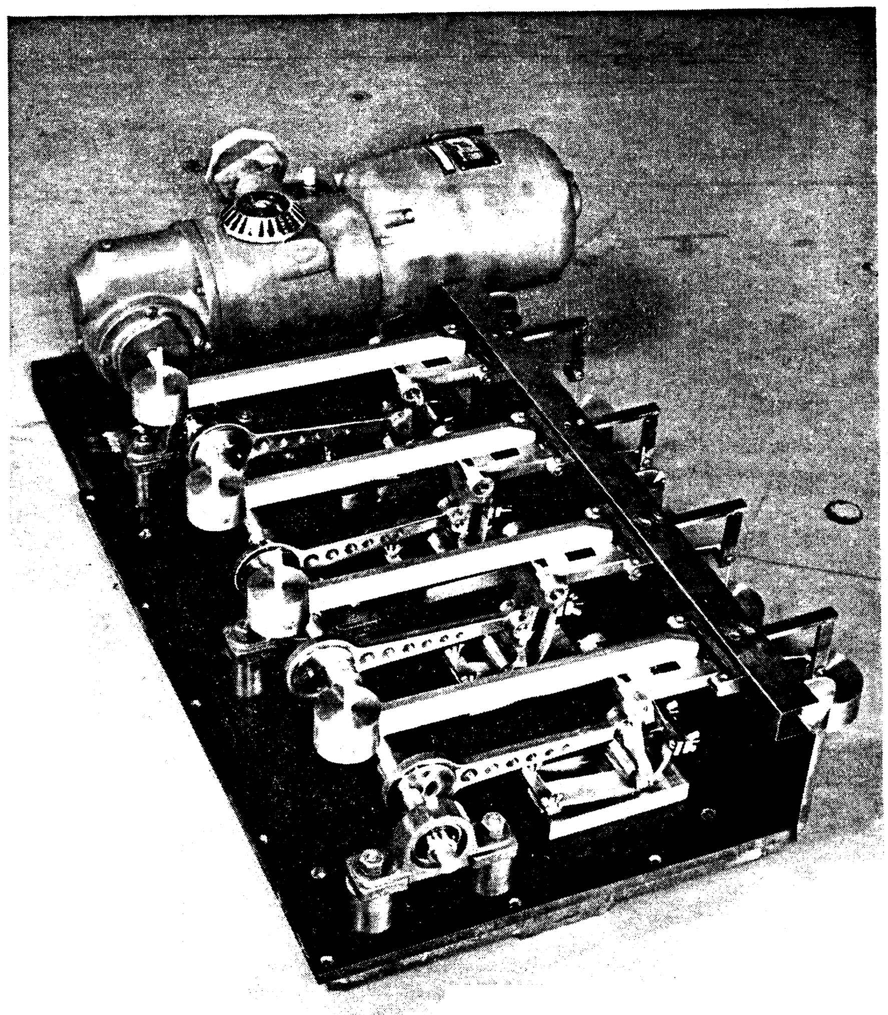

FIGURE 1.—Insole leather tester.

The specimen is supported on a brass block, A, 5 x 2.5 x 0.75 inches in size, with a curved depression 4 x 2.4 inches in area and approximately 0.4 inches deep at the lowest point (center) and curved to conform to the arc described by the roller, G. The leather test specimen, B, may be from 5 to 6 inches long and from 1 to 1.5 inches wide. The specimen is held at one end by a fixed clamp, C. and at the other end by a movable clamp, D. Slight tension is applied to the specimen by means of the 2.5 pound weight, E, which is

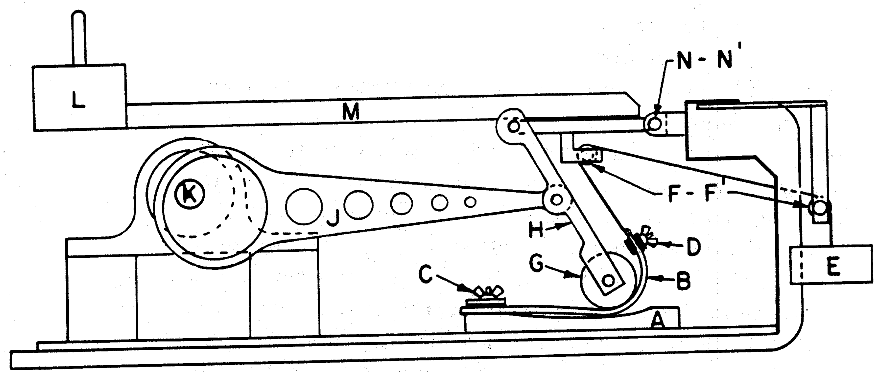

FIGURE 2.—Flexing mechanism of insole leather tester.

free to move vertically and which is attached to clamp, D, by a chain or a rawhide lace passing over small pulleys, F,F′. This tension causes the leather to flex around the brass roller G, which applies rolling pressure to the specimen. The roller is 1 inch in diameter, 1.5 inches long and is supported in the roller arm, H, by needle bearings. The roller arm and roller are driven by an eccentric and connecting rod, J. The stroke of the connecting rod is 1 inch and that of the roller is approximately 2 inches. Motion is supplied to the eccentric by the drive shaft, K, driven through a variable speed reducer so that the shaft speed can be varied from 15 to 125 revolutions per minute. Pressure is applied to the roller by the weight, L, acting through the lever arm, M, with fulcrum at the bearings, N,N′. The long arm is 12 and the short arm 3 inches long so that a weight of 1 pound at L applies a pressure of 4 pounds on the roller. A 1 pound weight, L, is shown in Figure 1 but additional weights can be added if desired.

The machine, excluding motor, is enclosed in a wooden case in order to maintain a uniform temperature and relative humidity around the specimens. The front and top panels of the case are made as one piece and hinged at the back. This "cover" can be lifted back so that the interior of the case is accessible for attaching specimens, adding sweat solution, or performing other necessary operations. There are large glass windows in the front and top panels of the cover.

A small, 3-inch fan circulates the air inside the case. A 600-watt, screw-type electric heater, connected through a variable transformer, permits hand temperature control to within a few degrees.

A counter mounted below the eccentric, J, and operated by a pin on J, records the number of times the specimen is flexed.

During a test the leather normally is kept damp, usually with water, artificial perspiration, or some modification of the perspiration formula. The solution can either be added at intervals from a pipette or equipment for adding it through the case can be installed if desired.

The machine is thus seen to be rather flexible. It is possible to vary the load on the specimen, the speed of flexing, the type of solution used for dampening the specimen, and the temperature. It is also possible, with some modifications to change the size of the roller.

In order to compare the pressure of a person on an insole with that of the roller on the specimen, some assumptions were necessary. It was assumed that the ball of a foot during a step covers about 5 square inches of the insole. The weight of a 200-pound person would, therefore, give a pressure of 40 pounds per square inch on the insole. The area of that part of the leather specimen which supports the load through the roller could only be estimated roughly. The length of this area was, of course, 1.5 inches. The width was assumed to be between $^1/_8$th and $^1/_{16}$th inches. A 4-pound load on the roller would, therefore, give a pressure of between 20 and 40 pounds per square inch on the leather. With a 1-pound weight at L, the pressure per unit area by the roller on a test specimen would then be roughly equivalent to that of a 100–200 pound person on his insole during walking. This was the standard weight used in testing with this machine.

Normally a rectangular specimen would be used for flexing on the machine, after which deterioration would be evaluated by tensile strength, stiffness or other measurements on test pieces cut from the specimen. During flexing, however, the specimen is distorted because of pressure, bending, and dampening. Tensile strength strips, for example, cut after machine flexing might, therefore, have quite different dimensions from those they would have had if cut before flexing. For comparative work, tensile strength specimens were cut as shown in Figure 3, before machine flexing. This was accomplished by putting a wooden block 3 inches wide under the middle of the 1 x 5 inch rectangular leather specimen, so that the die would cut only the narrow portion, B, (either ½ inch or 1 cm. wide) and shoulders of the test strip. Specimens cut in this manner behaved satisfactorily in the machine. After machine

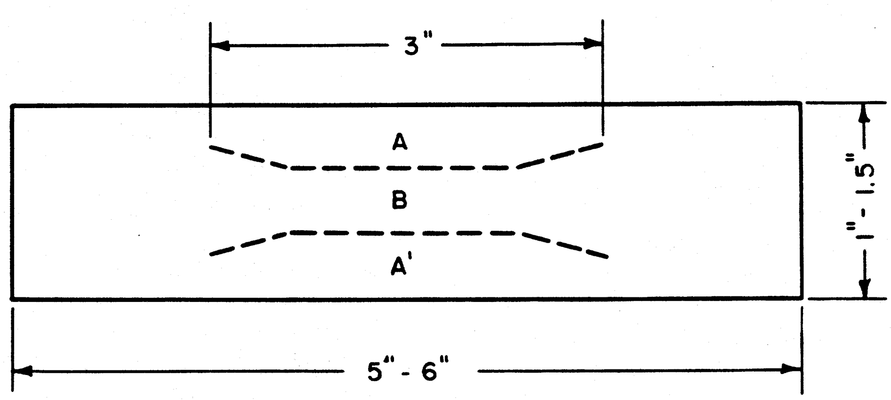

FIGURE 3.—Specimen for comparative work; permitting tensile strength measurement on either original dimensions or dimensions after machine flexing.

flexing, the side strips, A,A′, (Figure 3) were cut off and used for observations on stiffness, crackiness and other properties. The remainder was broken for strength. This method of precutting strength strips was useful for determining the effect of a given treatment or for comparing several treatments. Provided, of course, that the experiment was properly planned with comparable sets of strips correctly assigned, the strength either of treated and untreated strips or of strips with different treatments could be directly compared. Also, if desired, the strip dimensions could be measured before and after machine flexing, and tensile strengths calculated on either or both

TABLE I

Effect of Varying Machine Speed, Load and Time of Flexing on the Tensile Strength of Vegetable-Tanned Insole Leather

				Tensile strength			
Load p. s. i.	Speed Cycles per min.	Cycles hundreds	Time Minutes	Block A Kg/cm2	Block B Kg/cm2	Block C Kg/cm2	Block D Kg/cm2
*	*	0	0	413	408	452	351
100	62	4	6	162	259	394	379
100	62	12	19	407	503	364	335
100	62	36	58	206	393	326	243
100	62	108	174	359	218	308	353
*	*	0	0	368	377	377	258
50	62	4	6	375	491	367	216
50	62	12	19	362	425	284	365
50	62	36	58	279	243	261	207
50	62	108	174	338	342	286	294
*	*	0	0	382	242	363	295
100	15	4	25	365	469	261	357
100	15	12	76	216	462	320	292
100	15	36	228	263	430	310	303
100	15	108	684	216	356	324	265
*	*	0	0	314	500	345	282
50	15	4	25	306	429	384	323
50	15	12	76	343	467	343	275
50	15	36	228	379	369	362	316
50	15	108	684	306	327	208	281
			Block Average	318	386	332	300

*Control, not flexed in machine.

bases by the usual method. Preliminaty data, shown in Tables I and II, on the effects of various machine adjustments on tensile strength of flexed specimens were obtained in continuous runs using comparable sets of specimens. After flexing on the machine the leather was dried, conditioned and tested. There were 4 replications or blocks. The artificial perspiration solution was

TABLE II

Average Tensile Strength Values (Rounded) for Different Machine Adjustments.
(from data of Table I)

Cycles	Load* Speed	100 62	50 62	100 15	50 15	Average
0		406	345	320	360	358
400		298	362	363	360	346
1200		402	359	322	357	360
3600		292	248	326	356	306
10800		310	315	290	280	299
Average		342	326	324	343	334

*Load in pounds per square inch; Speed in cylces per minute.

made according to the formula given in Federal Specification KK-L-311, with with 1 per cent of urea in addition.

Analysis of the data indicates that tensile strength was not influenced by the load on the roller or by the speed of flexing, but decreased somewhat as the number of flexes increased.

High tensile strength would not appear to be an important requirement for insole leather, therefore other tests for measuring insole deterioration were sought. No better method, however, has yet been found. This apparently agrees with the findings of Kremen, who uses tensile strength for his evaluation of insole leather deterioration. Measurement of stiffness of the flexed tensile strength strips before breaking was considered. Machine flexing, however, tended to decrease stiffness, therefore, this type of measurement does not seem suitable for evaluating the results of this test.

Acknowledgment

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Referencfs

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